

## CLAIMS

- 1     1.     A micro-electronic mechanical system actuator, comprising:  
2             an actuator stage coupled with a pull-rod.
  
- 1     2.     The micro-electronic mechanical system of claim 1, wherein:  
2             the actuator stage includes an arm composed of a first material and a second  
3     material, wherein the first material has a coefficient of expansion that is lower than the second material's  
4     coefficient of expansion.
  
- 1     3.     The micro-electronic mechanical system of claim 2, including an input signal coupled with the arm.
  
- 1     4.     The micro-electronic mechanical system of claim 3, wherein:  
2             the first material is stimulated by the input signal such that the first material expands  
3     at a greater rate than the second material.
  
- 1     5.     A micro-electronic mechanical system actuator, comprising:  
2             a bottom stage, including a plurality of bottom arms, coupled to a top stage,  
3     including a plurality of top arms, through a first coupling bar and a second coupling bar.
  
- 1     6.     A method for actuating in a micro-electronic mechanical system, comprising:

supporting a first material with a second material;  
applying an input signal;  
heating the first material such that the first material expands faster than the second material; and  
outputting a movement that is along a direction that passes from the first material to the second material.

7. The method for actuating a micro-electronic mechanical system of claim 6, including:  
coupling the output movement with a platform such that the platform is moved as a result of the output movement.

8. A micro-electronic mechanical system actuator, comprising:  
a top stage including a top arm, wherein:  
the top arm is composed of a first material and a second material; and  
the first material has a coefficient of expansion that is lower than the second material's coefficient of expansion;  
a bottom stage including a bottom arm, wherein:  
the bottom arm is composed of a third material and a fourth material; and  
the third material has a coefficient of expansion that is lower than the fourth material's coefficient of expansion; and

10 a pull-rod that couples the top stage with the bottom stage.

1 9. A micro-electronic mechanical system actuator, comprising:

2 a top stage including a first top arm and a second top arm, wherein:

3 the first top arm is composed of a first material with a low coefficient of  
4 expansion and a second material with a high coefficient of expansion;

5 the second top arm is composed of a third material with a low coefficient  
6 of expansion and a fourth material with a high coefficient of expansion;

7 a bottom stage including a first bottom arm and a second bottom arm, wherein:

8 the first bottom arm is composed of a fifth material with a low coefficient  
9 of expansion and a sixth material with a high coefficient of expansion;

10 the second bottom arm is composed of a seventh material with a low  
11 coefficient of expansion and an eighth material with a high coefficient of expansion.

1 10. The micro-electronic mechanical system actuator of claim 9, including a first coupling bar that  
2 couples the top stage with the bottom stage.

1 11. The micro-electronic mechanical system actuator of claim 10, including: a second coupling bar that  
2 couples the top stage with the bottom stage.

1 12. The micro-electronic mechanical system actuator of claim 11 wherein the top stage moves when  
2 the first top arm and the second top arm are stimulated by an input signal such that the first top arm expands  
3 at a greater rate than the second top arm.

1 13. The micro-electronic mechanical system actuator of claim 12 wherein the bottom stage  
2 moves when the first bottom arm and the second bottom arm are stimulated by an input signal such that the  
3 first bottom arm expands at a greater rate than the second bottom arm.

1 14. The micro-electronic mechanical system actuator of claim 13 wherein the first and  
2 second coupling bars allow the top stage to move with the bottom stage, and the bottom stage to move with  
3 the top stage, thereby increasing the range of motion of the top and bottom stages.

1 15. The micro-electronic mechanical system actuator of claim 14, including a pull-rod coupled with the  
2 top stage.

1 16. A fault tolerant micro-electronic mechanical system actuator, comprising:  
2 a top stage including a first set of top arms and a second set of top arms, wherein:  
3 each top arm from said first set is composed of a first material with a low coefficient  
4 of expansion and a second material with a high coefficient of expansion;  
5 each top arm from said second set is composed of a third material with a low

coefficient of expansion and a fourth material with a high coefficient of expansion;  
a bottom stage including a first set of bottom arms and a second set of bottom arms,  
wherein:  
each bottom arm from said first set is composed of a fifth material with a low  
coefficient of expansion and a sixth material with a high coefficient of expansion;  
each bottom arm from said second set is composed of a seventh material with a  
low coefficient of expansion and an eighth material with a high coefficient of expansion.

17. The fault tolerant micro-electronic mechanical system actuator of claim 16 wherein:  
one or more of the top arms from the first set and one or more of the top arms  
from the second set are required to complete a circuit; and  
one or more of the bottom arms from the first set and one or more of the bottom  
arms from the second set are required to complete a circuit.

18. The fault tolerant micro-electronic mechanical system actuator of claim 17, including a  
first coupling bar that couples the top stage with the bottom stage.

19. The fault tolerant micro-electronic mechanical system actuator of claim 18, including: a  
second coupling bar that couples the top stage with the bottom stage.

1     20.     The fault tolerant micro-electronic mechanical system actuator of claim 19 wherein the  
2     top stage moves when the first set of top arms and the second set of top arms are stimulated by an input  
3     signal such that the second material expands at a greater rate than the first material and the fourth material  
4     expands at a greater rate than the third material.

1     21.     The fault tolerant micro-electronic mechanical system actuator of claim 20 wherein the  
2     bottom stage moves when the first bottom arm and the second bottom arm are stimulated by an input signal  
3     such that the sixth material expands at a greater rate than the fifth material and the eighth material expands  
4     at a greater rate than the seventh material.

1     22.     The fault tolerant micro-electronic mechanical system actuator of claim 21 wherein the  
2     first and second coupling bars allow the top stage to move with the bottom stage, and the bottom stage to  
3     move with the top stage, thereby increasing the range of motion of the top and bottom stages.

1     23.     The fault tolerant micro-electronic mechanical system actuator of claim 22, including a  
2     pull-rod coupled with the top stage.